

PRELIMINARY AMENDMENT  
National Stage Entry  
of PCT/GB2003/003807

AMENDMENTS TO THE CLAIMS

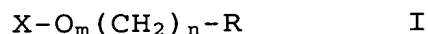
This listing of claims will replace all prior versions and listings of claims in the application:

**LISTING OF CLAIMS:**

Claim 1. (Original) An ionic dopant comprising a sulfur or a phosphorus containing anion with a random cation, for use in a smectic A liquid crystal composition, wherein the dopant is capable of reducing the driving voltage of the smectic A liquid crystal device and enhancing dynamic light scattering.

Claim 2. (Original) An ionic dopant as claimed in claim 1, wherein the sulfur or phosphorus containing anion comprises X, and X is one of the following  $S^-$ ,  $SO_2^-$ ,  $SO_3^-$ ,  $SO_4^-$ ,  $NHSO_3^-$ ,  $POH^-$ ,  $PO_2H^-$ ,  $PO_3H^-$ ,  $(PO_3)^{2-}$ ,  $PO_4H^-$  or  $(PO_4)^{2-}$ .

Claim 3. (Original) An ionic dopant as claimed in either of the preceding claims, wherein the anion is according to formula I:



wherein X is  $S^-$ ,  $SO_2^-$ ,  $SO_3^-$ ,  $NHSO_3^-$ ,  $POH^-$ ,  $PO_2H^-$ ,  $PO_3H^-$  or  $(PO_3)^{2-}$ ; m is 0 or 1; n is 0 to 19; and R is  $R^3$ ,  $R^1R^3$ ,  $R^1-(CO_2)-R^3$ ,  $R^1-(CO_2)-R^2R^3$ ,  $R^1-(CH_2)_p-R^3$ , or  $R^1-(CH_2)_p-R^2R^3$ , wherein  $R^1$  is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene;  $R^2$  is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine,

**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**

a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene;  $R^3$  is a hydrogen, a cyano group, an alkyl chain, an alkyl substituted cyclohexyl, an alkenyl chain, an alkyl chain wherein one or more non-adjacent  $CH_2$ -groups are replaced by an oxygen atom; and p is 0 to 19.

Claim 4. (Original) An ionic dopant as claimed in claim 3, wherein the anion comprises:



wherein X is  $SO_3^-$ ,  $(PO_3H)^-$ ,  $PO_3^{2-}$ , and  $R^3$  is an alkyl or alkoxy chain.

Claim 5. (Original) An ionic dopant as claimed in claim 1, wherein the anion is chiral.

Claim 6. (Original) An ionic dopant comprising a quaternary ammonium cation with an anion, for use in a smectic A liquid crystal composition, wherein the dopant is capable of reducing the driving voltage of the smectic A liquid crystal device and enhancing dynamic light scattering.

Claim 7. (Currently Amended) An ionic dopant as claimed in ~~any one of claims 1-4~~claim 1, wherein the cation is a quaternary ammonium cation.

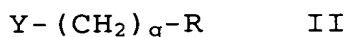
Claim 8. (Currently Amended) An ionic dopant as claimed in ~~any one of the preceding claims~~claim 1, wherein the cation is based on a heterocyclic base.

Claim 9. (Original) An ionic dopant as claimed in claim 7, wherein the cation is based on an N-alkylpyridine, an N-N'-dialkylimidazole an N-N'-dialkylbenzimidazole, an

**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**

N-N'-dialkyltriazole, an N-alkylquinuclidine or an N-alkylazanaphthalene.

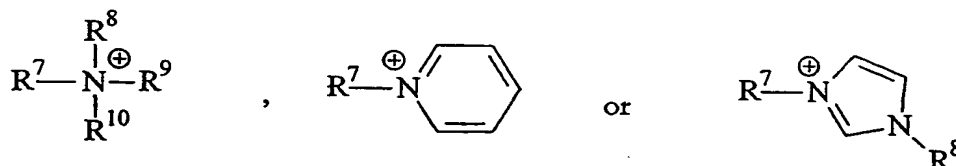
Claim 10. (Currently Amended) An ionic dopant as claimed in ~~any one of the preceding claims~~ claim 1, wherein the cation is according to formula II:



wherein Y is  $NR^4R^5R^6$  wherein  $R^4$ ,  $R^5$  and  $R^6$  is in every instance an alkyl group or an alkyl chain containing 0 to 5 carbon atoms, pyridines, N-alkylimidazoles, N-alkylbenzimidazoles, N-alkyltriazoles, alkylquinuclidines or alkylazanaphthalenes, q is 0 to 19; and R is  $R^3$ ,  $R^1R^3$ ,  $R^1-(CO_2)-R^3$ ,  $R^1-(CO_2)-R^2R^3$ ,  $R^1-(CH_2)_p-R^3$ , or  $R^1-(CH_2)_p-R^2R^3$ , wherein  $R^1$  is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene;  $R^2$  is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene;  $R^3$  is a hydrogen, a cyano group, an alkyl chain, an alkyl substituted cyclohexyl, an alkenyl chain, an alkyl chain wherein one or more non-adjacent  $CH_2$ -groups are replaced by an oxygen atom; and p is 0 to 19.

**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**

Claim 11. (Currently Amended) An ionic dopant as claimed in ~~any one of the preceding claims~~ claim 1, wherein the cation is:

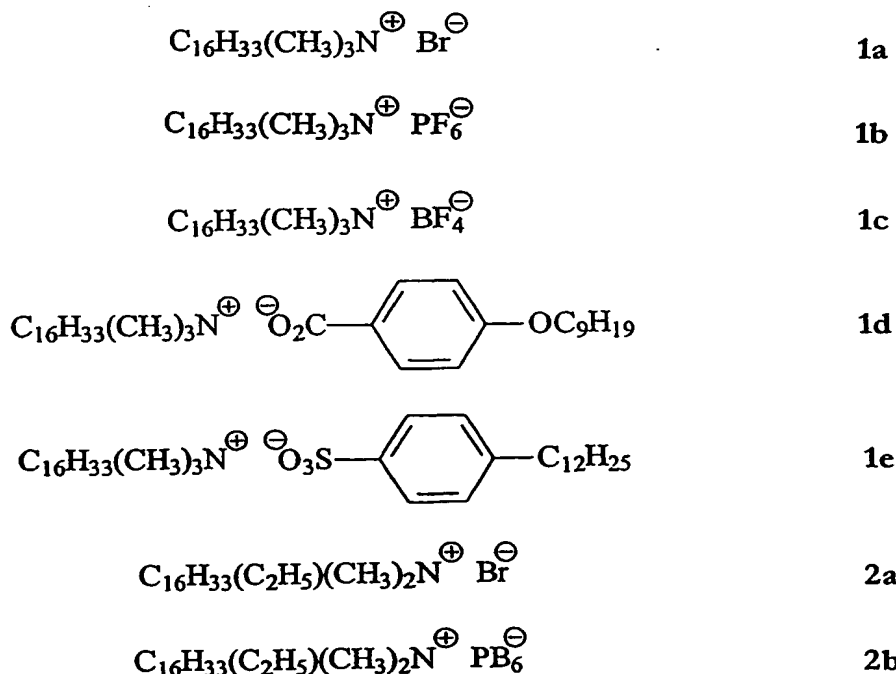


where  $\text{R}^7$ ,  $\text{R}^8$ ,  $\text{R}^9$  and  $\text{R}^{10}$  are alkyl chains.

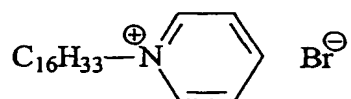
Claim 12. (Currently Amended) An ionic dopant as claimed in ~~any one of the preceding claims~~ claim 1, wherein the cation is *n*-hexadecyltrimethylammonium (HTMA) or *n*-hexadecyldimethylethylammonium (HDME).

Claim 13. (Original) An ionic dopant as claimed in claim 7, wherein the cation is chiral.

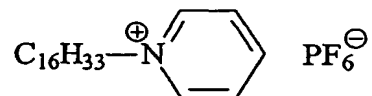
Claim 14. (Currently Amended) An ionic dopant as claimed in ~~any one of the preceding claims~~ claim 1, wherein the dopant is:



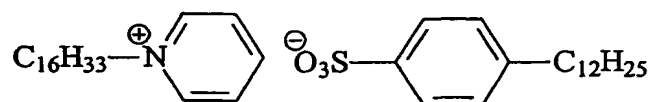
**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**



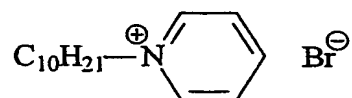
3a



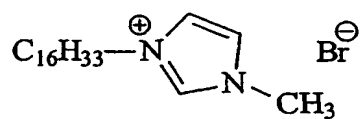
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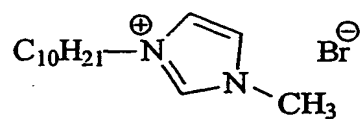
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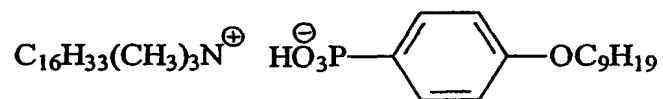
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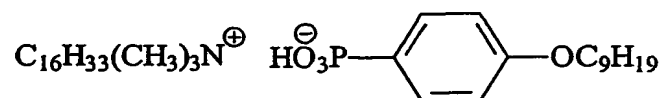
5a



6a

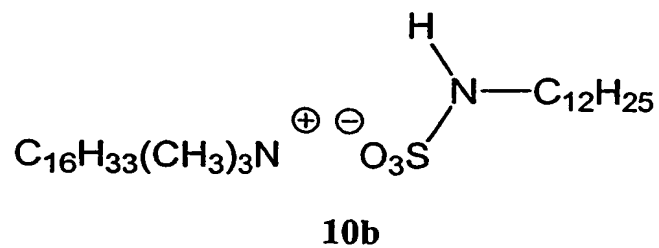
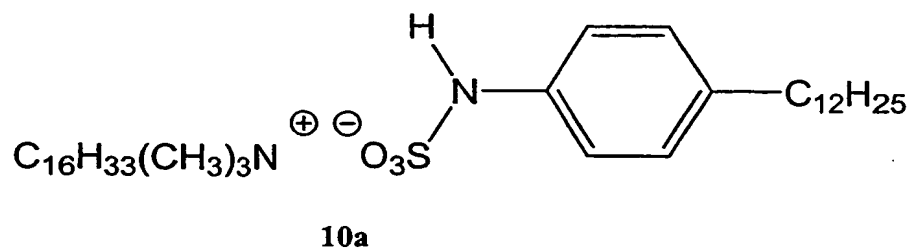
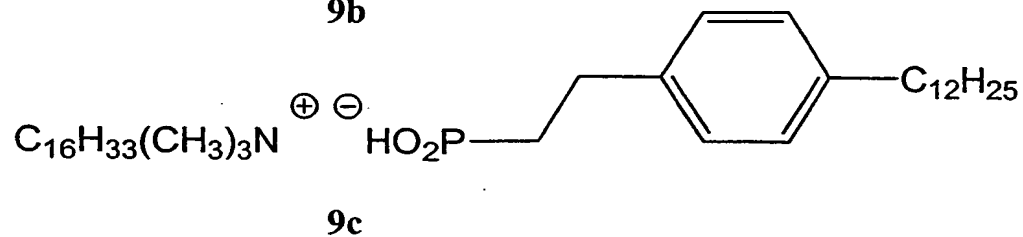
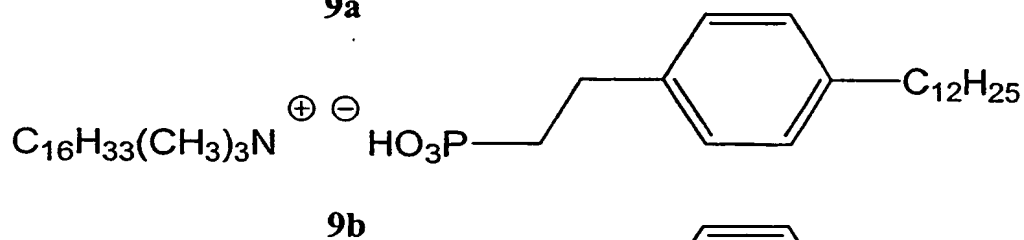
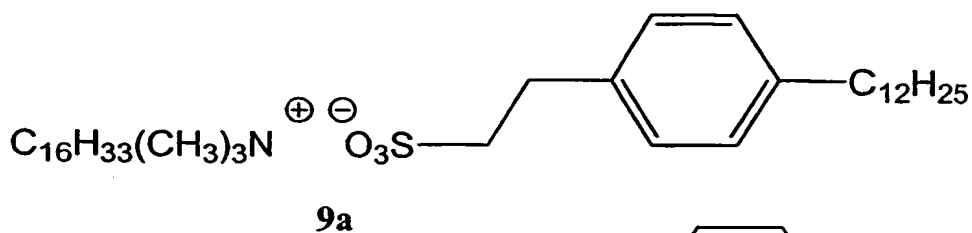
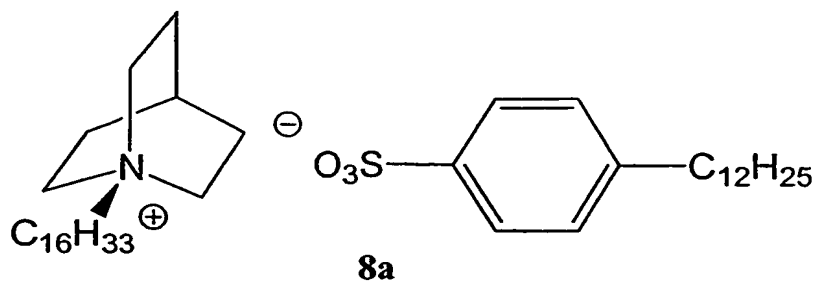


7a

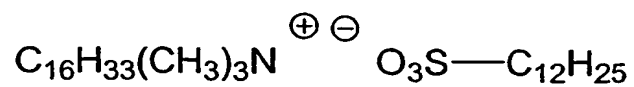


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**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**



**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**



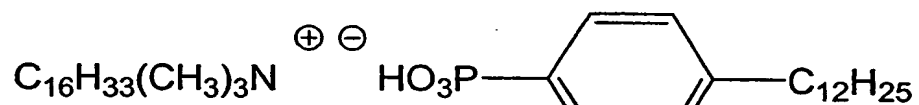
**11a**



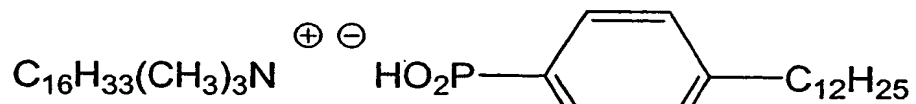
**11b**



**11c**

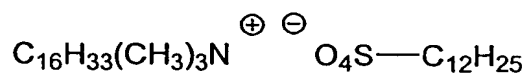


**11d**



**11e**

**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**



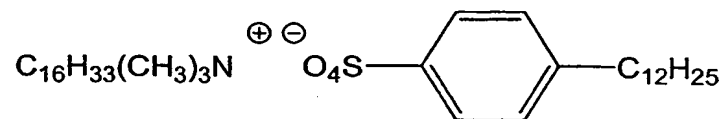
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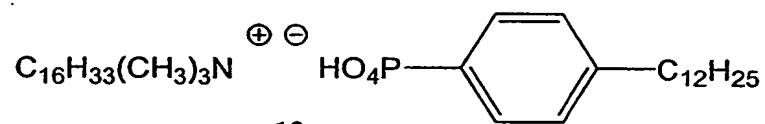
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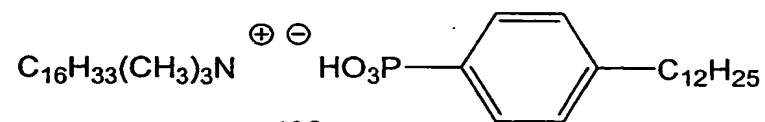
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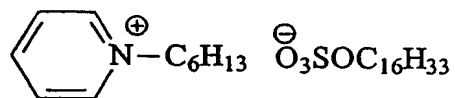
**12d**



**12e**



**12f**



**13a**

**PRELIMINARY AMENDMENT**  
**National Stage Entry**  
**of PCT/GB2003/003807**

Claim 15. (Currently Amended) A smectic A liquid crystal composition comprising one or more ionic dopants as claimed in ~~any one of the preceding claims~~claim 1.

Claim 16. (Original) A device containing a smectic A liquid crystal composition as claimed in claim 15.

Claim 17. (Original) A device as claimed in claim 16, wherein the device is a display or a light shutter.

Claim 18. (Currently Amended) A method of doping a smectic A liquid crystal composition, by adding an ionic dopant as claimed in ~~any one of claims 1-14~~claim 1 to a smectic A liquid crystal composition.